

THERMAL EFFECTS OF BIOLOGICAL MAGNIFICATION OF ARSENIC IN GREEN SUNFISH, LEPOMIS CYANELLUS

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The pattern of heavy metal concentration in organs of both living and dead Lepomis cyanellus was measured in Section I as a function of exposure time at 10⁰, 20⁰, and 30⁰C and 0, 30, and 60 ppm arsenic as sodium arsenate. The temperature quotient (Q_{10}) for the rate of arsenic uptake and the lethal time before 50% mortalities (LT_{50}) occurred were calculated.

Arsenic concentration in liver, gut, and muscle tissue was determined in living and dead specimens by neutron activation analysis. The occurrence of individual specimen variability in arsenic uptake data did not override general trends of increasing uptake with exposure time, temperature, and arsenic concentration. Data on the arsenic retention of fish in 10⁰C and 0, 30, and 60 ppm treatments indicated that the majority of arsenic in organs is not retained after 7 days. Correlation of uptake with various specimen and tissue parameters proved inconclusive.

The mean Q_{10} value for arsenic uptake in liver was 4.5. Since the typical Q_{10} range for the genus Lepomis is 1.6 to 3.0 (O'Hara, 1968), the high mean Q_{10} for L. cyanellus seems to suggest that temperature acts synergistically with arsenic uptake.

The LT_{50} values, a measure of survival, were calculated by straight line graphic interpolation after linear regression analysis of data on % survival versus time of death. All regressions were highly significant. As temperature increased from 10⁰ to 20⁰ to 30⁰C at 60 ppm arsenic, % survival decreased such that LT_{50} values were reduced from 678 to 210 to 124 hours, respectively. For an arsenic concentration of 30 ppm and temperatures of 20⁰ and 30⁰C, LT_{50} values are 527 and 209 hours, respectively.

Since the results of Section I showed that arsenic was accumulated in organs--especially the liver--of Lepomis cyanellus and that external variations exacerbate this accumulation, an intracellular study was made in Section II to follow the appearance and rate of change of hepatocyte alterations. Hepatocyte alteration was measured as arsenic concentration (i.e., 30 and 60 ppm) and exposure time (i.e., 1, 2, and 3 weeks) varied at 20⁰.

As concentration and exposure time increased, the appearance and increase in aberrant mitochondria and electron dense particles were observed. Lysosomes and smooth endoplasmic reticulum increased in number, while the number of myelin figures decreased. Hepatocyte alterations and arsenic uptake did not appear to be correlated to specimen condition.

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